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Confinement effect of chain dynamics in micrometer thick layers of a polymer melt below the critical molecular weight

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Abstract

Polymer melts confined in micrometer thick layers were examined with the aid of field-cycling NMR relaxometry. It is shown that chain dynamics under such moderate confinement conditions are perceptibly different from those observed in the bulk material. This is considered to be a consequence of the corset effect, which predicts a crossover between Rouse and reptationlike dynamics for molecular weights below the critical value at confinement length scales much larger than 10RF, where RF is the Flory radius of the bulk polymer coil [Fatkullin et al., New J. Phys. 6, 46 (2004)]. For the polymer species studied, a perfluoropolyether with a molecular weight of 11 000, the Flory radius is of the order 10 nm, so that the experiment refers to the far end of the predicted crossover region from confined to bulk chain dynamics. Remarkably the confinement effect is shown to reach polymer-wall distances of the order 100 Flory radii. © 2005 American Institute of Physics.

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